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GB 1473537 A

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(54) Stereo camera

(57) A stereo camera 10 comprises a single objective lens 14 which forms a parallel beam of light from any point on an object 13, a single image-forming lens 20, and a biprism 16 between the two lenses. Preferably at least the image-forming lens 20 is a compound lens arranged so its exit pupil, for an entrance pupil near the biprism 16, is near the rear surface of the lens 20. A baffle-plate 24, 25 of T-shaped cross-section behind the lens 20 minimizes overlap of the two images. The camera can provide stereo photography or television images, and can be of small diameter for use in confined spaces.

The optical components of the camera may be used in reverse to recombine a pair of stereoscopic images.

Fig.1.

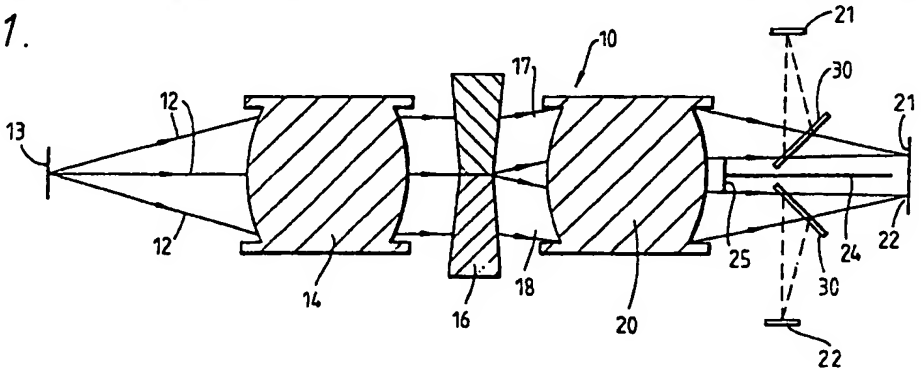

Fig.2.

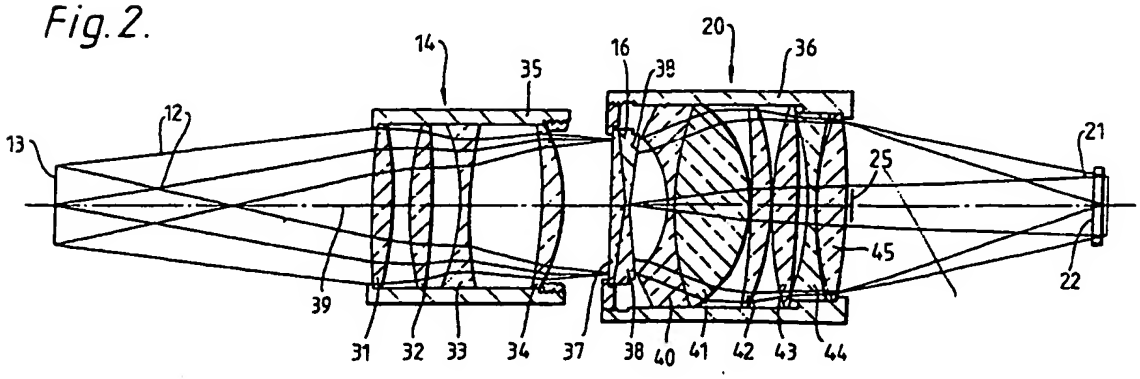

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Fig.1.

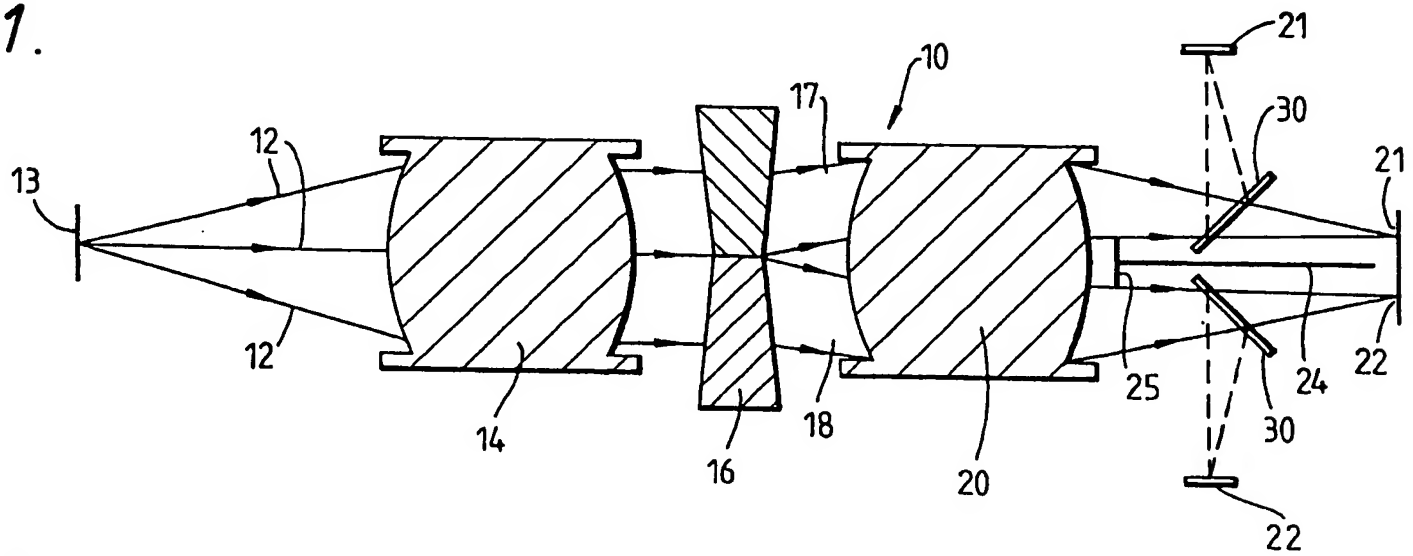
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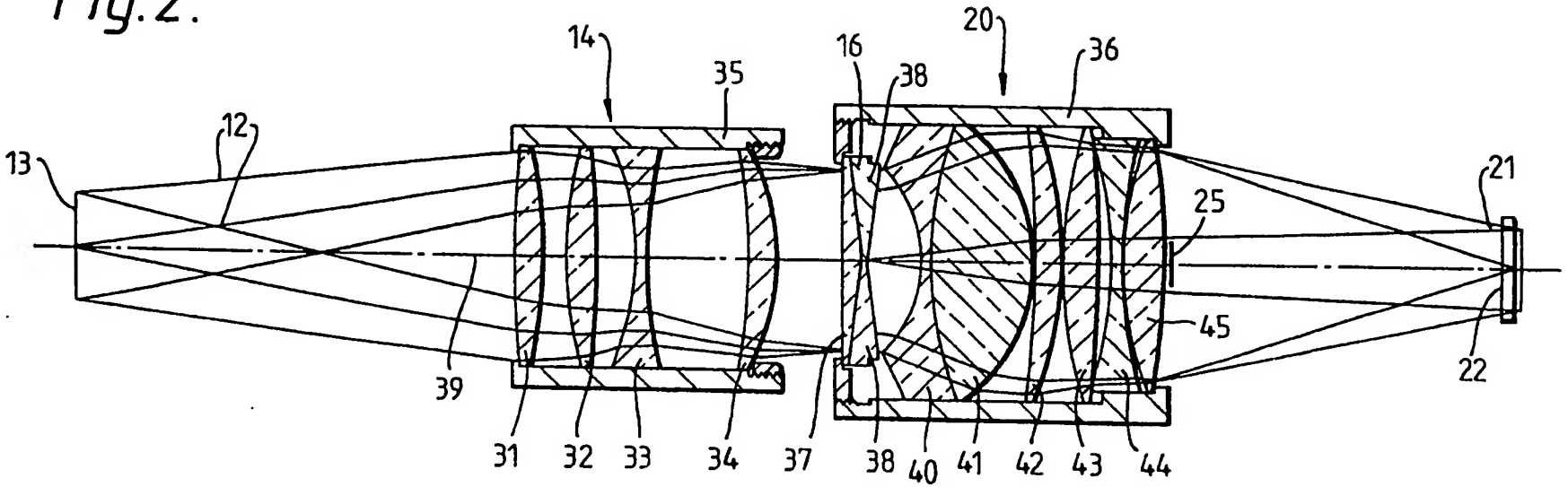
Fig.2.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Stereo Camera

This invention relates to a stereo camera and paticularly but not exclusively to a stereo camera for providing stereoscopic television pictures.

According to the present invention there is provided a stereo camera comprising a single objective lens, a light-sensitive imaging device, a single image-focussing lens for focussing images onto the light-sensitive device, and a biprism between the objective lens and the image-focussing lens so that two images are created.

By using a single objective lens rather than two side-by-side objective lenses a much more compact stereo camera can be made, so enabling inspection in confined spaces for example. It will be appreciated that the objective lens and the image-focussing lens may both be compound lenses, that is to say each may comprise a plurality of lenses with a common optical axis.

Preferably a baffle is provided, extending between the light-sensitive device and the image-focussing lens in a plane parallel to the optical axis of the image-focussing lens and in which the vertex of the biprism lies. This prevents any overlap of the two images. The baffle is desirably T-shaped, with the cross-bar of the T adjacent to the image-focussing lens and perpendicular to its optical axis.

Preferably the objective lens is a collimating lens, so light from a point on an object is incident as a parallel beam onto the biprism. Consequently the distance between the objective lens and the biprism is not critical. The camera is focussed by moving the objective lens towards or away from an object, and no movement of the other

components is necessary. Alternatively the objective lens might have the nature of a telescope, comprising two converging lenses spaced apart and arranged to form an intermediate image between them, and to ensure light from a point on the object is incident onto the biprism as a parallel beam.

The image-focussing lens is preferably such that for an entrance pupil at the location of the biprism, the corresponding exit pupil, which is virtual, is as close as possible to the cross-bar of the baffle, so as to minimise the light loss due to the baffle. In the embodiment of the invention described below, the exit pupil would be only about 120 mm from the cross-bar (to the side of the cross-bar remote from the sensor); by contrast with a conventional lens the exit pupil would be about 200 mm from the cross-bar.

The light-sensitive imaging device might be a photographic film, or might be an electronic image sensor. The two images may be produced side-by-side, and may be formed on a common imaging device, or by means of mirrors the two images may be formed on two separate imaging devices.

The optical components of the camera might also be used in reverse to recombine a pair of stereo images.

The invention will now be further described by way of example only, and with reference to the accompanying drawings in which:

Figure 1 shows a diagrammatic sectional view of a stereo camera; and

Figure 2 shows a sectional view, in greater detail, of the camera of Figure 1.

Referring to Figure 1, there is shown a sectional view along the optical axis of a stereo camera 10. Light rays 12 from an object 13 are collimated by a collimating lens 14 so as to be incident as parallel rays onto a biprism 16. The biprism 16 splits the light into two parallel beams 17, 18 which diverge. The beams 17 and 18 are focussed by an image-forming lens 20 to form two side-by-side images 21, 22 above and below the optical axis of the camera 10 respectively. A baffle plate 24 extends along the optical axis from near the rear surface of the lens 20 to near the plane in which the images 21, 22 lie; this is a flat plate in the plane perpendicular to the Figure (i.e. the plane in which the vertex of the biprism 16 lies, that is to say the plane dividing the two parts of the biprism 16), and is T-shaped with a cross-bar 25 near the rear surface of the lens 20 and perpendicular to the optical axis of the camera 10. The baffle plate 24 with its cross-bar 25 minimises any overlap of the two images 21 and 22.

In a modification to the above-described arrangement, indicated by broken lines, mirrors 30 are used so that the two images 21 and 22 are formed spaced well apart from each other. This modification is advantageous where the images 21 and 22 are to be formed on two separate electronic image sensors, as more space is thereby provided for each sensor.

Referring now to Figure 2, the stereo camera 10 is shown in greater detail. The collimating lens 14 is a compound lens with four spaced-apart component lenses 31, 32, 33, 34 held in a tubular metal support 35. The biprism 16 and the image-forming lens 20 are also held in a respective tubular metal support 36. The biprism 16 is of doublet construction to minimise chromatic aberration, and consists of a first biprism 37, plane on one side and on the other side defining two surfaces inclined at 7.9

degrees to the plane surface, and two thin prisms 38 of vertex angle 15.6 degrees fixed to the inclined surfaces of the first biprism 37 with their vertices together (and intersecting the optical axis 39). The first biprism 37 is of type F2 glass and the prisms 38 are of type BK7 glass, these being the Schott glass type numbers. The image-forming lens 20 is also of compound form, comprising a thick doublet meniscus lens (lenses 40 and 41), and four other spaced-apart single lenses 42, 43, 44 and 45. The cross-bar 25 in this case is 8.5 mm high, and abuts the rear surface of the lens 45.

The characteristics of the lenses are listed in the Tables which indicate the radii of the successive surfaces, the separation along the axis 39 between one surface and the next, the clear diameters, and the types of glass. The lenses of the collimating lens 14 are indicated in Table 1, and those of the imaging-forming lens 20 in Table 2. It will be appreciated that the overall diameter of the collimating lens 14 including the support 35 need be no more than about 45 mm, while that of the image-forming lens 20 need be no more than about 55 mm.

As mentioned earlier, the optical components of the camera, that is the collimating lens 14, the biprism 16, and the image-forming lens 20, can be used in reverse to recombine a pair of stereoscopic images. In this case the stereoscopic images would be placed in the position of the images 21 and 22 of Figure 1.

Table 1

Radius/mm	Separation/mm	Diameter/mm	Material	Lens
250		40		
	5.5		LAK9	31
-92		40		
	4.1		air	
78		40		
	6.0		BK7	32
-206		38		
	7.4		air	
-55		38		
	2.0		SF8	33
91		38		
	19.6		air	
-112		38		
	5.5		SK4	34
-43		39		

Table 2

Radius/mm	Separation/mm	Diameter/mm	Material	Lens
	10.6		air	
-24		35		
	1.5		LAK9	40
68		50		
	20.0		SSK5	41
-33		50		
	0.3		air	
-205		50		
	5.0		LAK9	42
-71		50		
	0.3		air	
82		50		
	7.0		LAK9	43
-213		47		
	2.6		air	
-72		47		
	1.5		SF6	44
86		46		
	0.35		air	
61		46		
	8.3		LAK9	45
-138		46		

Claims

1. A stereo camera comprising a single objective lens, a light-sensitive imaging device, a single image-focussing lens for focussing images onto the light-sensitive device, and a biprism between the objective lens and the image-focussing lens so that two images are created.

2. A stereo camera as claimed in Claim 1 also comprising a baffle extending between the light-sensitive device and the image-focussing lens to prevent light crossing the plane parallel to the optical axis of the image-focussing lens in which the vertex of the biprism lies.

3. A stereo camera as claimed in Claim 2 wherein the baffle includes an element adjacent to the image-focussing lens, obstructing light emerging from the image-focussing lens in a region on each side of said plane.

4. A stereo camera as claimed in Claim 3 wherein the baffle is T-shaped, with the cross-bar of the T adjacent to the image-focussing lens and perpendicular to its optical axis.

5. A stereo camera as claimed in any one of the preceding Claims wherein the objective lens is a collimating lens.

6. A stereo camera as claimed in any one of the preceding Claims wherein both the objective lens and the image-focussing lens are compound lenses.

7. A stereo camera substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

8. An optical instrument for recombining a pair of

stereoscopic images, comprising a single converging objective lens for receiving light from the two stereoscopic images, the two images being at equal optical distances from the objective lens and light from the two images being received by respective non-overlapping segments of the objective lens, a single focussing lens, and a biprism between the objective lens and the focussing lens arranged such that the light received by the said segments passes through respective prisms of the biprism, so the focussing lens creates a single image.

9. An optical instrument as claimed in Claim 8 also including a baffle arranged to prevent light from one image being received by the segment of the objective lens corresponding to the other image.

10. An optical instrument as claimed in Claim 8 or Claim 9 also including means to prevent light from either image being received by a region of the objective lens lying between the said segments.

11. An optical instrument for recombining a pair of stereoscopic images, substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9212289.4

Relevant Technical fields

(i) UK Cl (Edition K) H4F (FDD) G2J (JB7P)

(ii) Int Cl (Edition 5) H04N G02B

Search Examiner

J COULES

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

9 SEPTEMBER 1992

Documents considered relevant following a search in respect of claims 1-11

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 1473537 (BUTTERFIELD) See wedge prisms 41, 42 in Figure 5	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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